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The gold belt buckle from Apahida III (Romania), 5th century AD

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Rodica Oanţă-Marghitu *, Gheorghe Niculescu **, Doina Şeclăman *,
Roxana Bugoi *** and Migdonia Georgescu **

Abstract: This study focuses on the understanding of the elaborate construction of a *cloisonné* gold belt buckle, found in a princely grave from Apahida, dated to the 5th century AD. Starting from the careful analysis of the object's proportions and dimensions, a geometrical pattern of the belt plate construction and decoration design is proposed. The intricate composition of this complicated *cloisonné* adorned object is also illustrated with the exploded view of its structure. X-Ray Fluorescence (XRF) analyses of the composition, performed on different elements forming the buckle, led to conclusions regarding the relations between the variation of gold purity and the role played by different elements in the structure of the object. Some sequences of actions from the entire *chaîne opératoire* are also emphasized. Most likely, there was a certain degree of standardization in the workshops producing these *cloisonné* objects, and probably the craftsmen had at their disposal large batches of individual constructive elements – cell walls and gems.

Résumé : *Cette étude se propose de décrire la construction élaborée de la boucle de ceinture en or et cloisonné, trouvée dans la tombe princière d'Apahida et datée du Ve siècle de notre ère. L'analyse minutieuse des proportions et dimensions de l'objet, a permis de proposer un motif géométrique, base de la construction de la plaque-boucle et du dessin de décoration. La composition très élaborée de cet objet de parure au cloisonné complexe est aussi illustrée par une vue éclatée de sa structure. Les analyses par fluorescence à rayons X (FX) de la composition des différents éléments de la boucle, ont apporté des hypothèses sur les rapports entre la variation de la pureté de l'or et le rôle joué par les différents éléments dans la structure de l'objet. Quelques séquences de la* chaîne opératoire *ont aussi été mises en évidence. Il est probable qu'un certain degré de standardisation avait été mis en place dans les ateliers de production de ces objets en cloisonné et que l'artisan avait à sa disposition de grands lots d'éléments individuels de construction – gemmes à sertir et cloisons.*

Keywords: gold, cloisonné, Apahida, 5th century AD, XRF.

Mots-clés : or, *cloisonné, Apahida, Ve siècle AD, FX*

1. Introduction

A large number of *cloisonné* adornments dated to the 5th-6th century AD were discovered by archaeological research and/or by chance on the former territory of the Roman Empire and also beyond its boundaries. Among all these artefacts, a group of items crafted in gold, inlaid with garnets on all visible sides, with S and Ω-shaped cells, undulated ('stepped') cell walls, and bordered with a string of small cabochon garnets can be distinguished (Werner,

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1958; Carnap-Bornheim, 1995; Schmauder, 2002: finds lists nos. 2, 3, 4). It was suggested that these spectacular pieces of jewellery, manufactured with special attention to every single detail, were most likely produced in the most prestigious workshops of the Roman Empire (Arrhenius, 1985: 100-124). The occasional presence of such exquisite ornaments deep in barbarian territory was explained as a result of diplomatic relations between the imperial court and the barbarian elite (Harhoiu, 1998: 155). To date, due to their special value and intricate structure, none of these objects was thoroughly investigated. The present paper tries to cover this gap by studying a gold belt buckle inlaid with garnets found at Apahida.

Three princely graves, all dating from the second half of the 5th century AD, were discovered at Apahida, near Cluj, the ancient Napoca (Fináły, 1889; Horedt and Protase, 1972; Matei, 1982; Harhoiu, 1998: 157-158; Périn *et al.*, 2000, 172-191). These finds made Apahida one of the most important sites on the map of the Migration Period in Europe. The impressive number of garnet inlaid objects that were preserved and the close resemblance with the adornments found in the Childeric grave from Tournai (Böhner 1981; Périn and Kazanski, 1996) emphasize its significance even more.

The existence of a third grave was deduced from the discovery of a gold belt buckle (Fig. 1) in 1979 (Matei, 1982)[1]. After its discovery and before being finally taken in custody by the National Bank of Romania, the buckle was dismantled, all garnets being extracted from the cells and the filling material completely removed. It is the unfortunate discovery conditions and the history of the artefact immediately after its recovery that favoured our investigation; this approach would have been impossible on a better preserved object.

In 2001, the National Bank of Romania donated the gold belt buckle from Apahida III to the National History Museum of Romania. At that moment the artefact was composed of 130 distinct elements: the buckle with a belt plate and a detachable tongue, all these ornamented with a total of 120 empty cells (Fig. 1, a-h); 34 gold fragments – thin patterned foils and cell walls (Fig. 1i); 56 garnets – among them, we can find both whole and broken stones, flat cut gems and oblong, slightly rounded garnets (Fig. 1j); 38 semispherical garnets – of which 26 are larger, initially mounted on the belt plate border, and 12 are smaller, initially mounted on the border of the tongue plate (kidney shaped) (Fig. 1k).

1. According to Prof. Dumitru Protase and Dr. Ioan Stanciu (personal communications), it is quite likely that this buckle is also part of the second Apahida grave inventory.

2. Premises and methods

As already mentioned above, this study focuses on the understanding of the elaborate construction of the *cloisonné* gold buckle found in the Apahida III grave. The poor conservation state of this artefact represents an advantage for the investigation, offering the opportunity for a better understanding of its construction.

By carefully examining the buckle, we noticed its extremely elaborate structure. Consequently, we concluded that the only possible way to assemble it was starting from an initial geometrically constructed project. By analyzing the ratios between different dimensions of the buckle, we found a solution for the construction of the buckle (Fig. 2a).

In order to obtain additional information on the manufacturing technologies, it was decided to perform X-Ray Fluorescence (XRF) measurements on as many as possible constructive elements of the belt buckle. Prior to the analysis, all gold items were cleaned in an ultrasonic bath.

The preliminary XRF analyses were performed using an Innov-X Systems Alpha Series X-Ray Fluorescence portable spectrometer with an X-ray tube based on a W anode, operated at 35 kV and 40 µA. Due to its technical characteristics, we used this equipment only for the investigation of the metallic elements larger than the sampling window (17 mm diameter) of the measuring head, or for the analysis of the smaller and detached elements, such as the patterned foils. These XRF measurements provided a rough estimate of the elemental composition for a number of gold components and stand-alone fragments. The results of these first XRF measurements on Apahida items were reported elsewhere (Niculescu *et al.*, in press).

However, due to the complicated structure of the object, it was necessary to refine the XRF information, especially for the areas that were difficult to reach using the portable spectrometer. Therefore, it was decided to perform a new set of analyses on different points from each metallic element composing the buckle – including the thin cell walls. These measurements were performed using an ARTAX 400 micro-XRF spectrometer, with an X-ray tube with a W anode, operated at 50 kV and 700 µA, with a 650 µm diameter collimator.

The quantification of the XRF measurements was performed through direct comparison of the count rates method and by using standards with known elemental concentrations, measured with exactly the same spectrometer settings as the investigated archaeological items. The standards were ternary Au-Ag-Cu alloys from the former

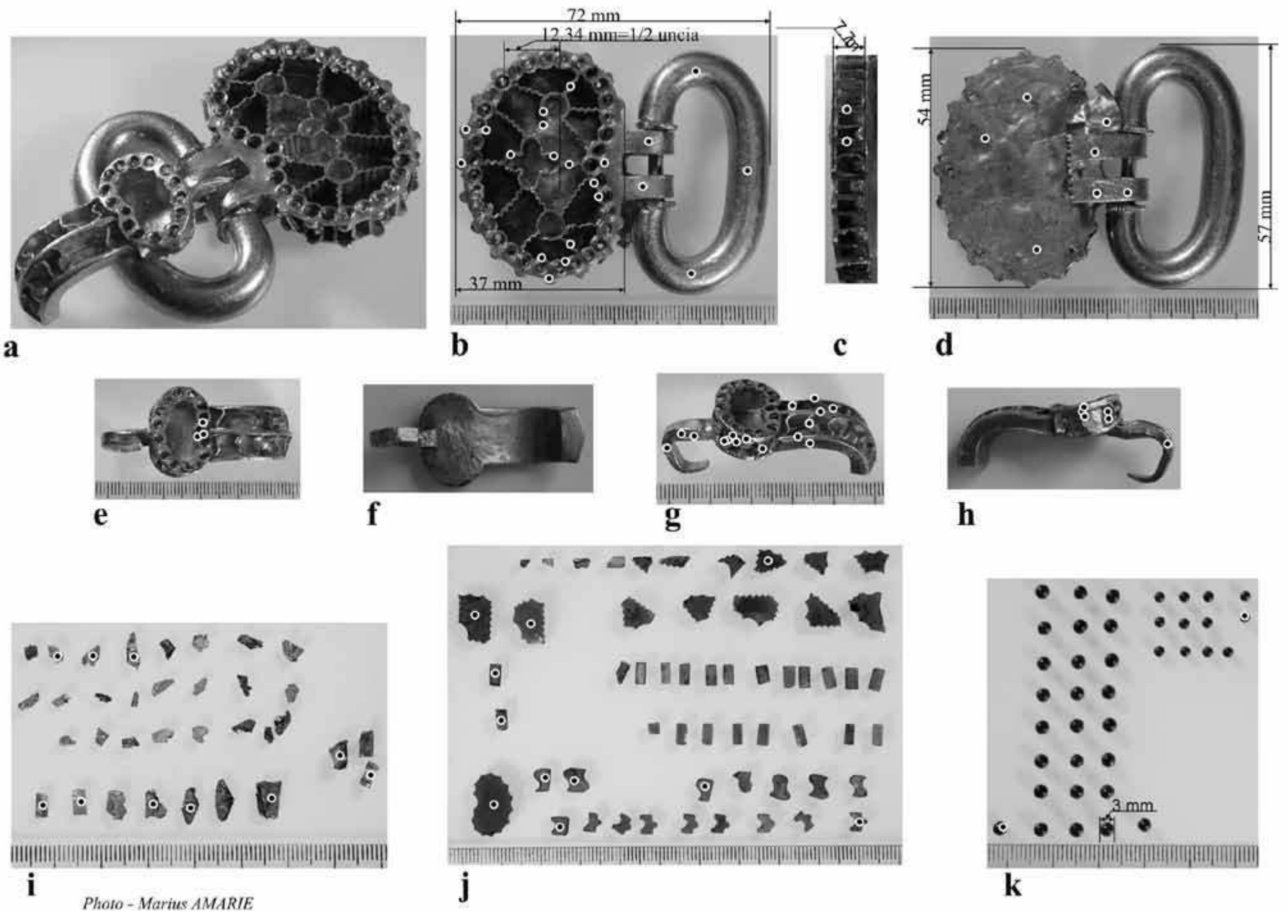

Figure 1: (See colour plate) Photographs showing the Apahida III belt buckle, as well as the related (and dismantled) parts. The black dots on the photographs indicate the points in which the XRF analyses were performed; the quantitative results are summarized in Figure 3.
Figure 1 : (Voir planche couleur) Photos illustrant la boucle de ceinture d'Apahida III ainsi que les parties en relation (et démontées). Les points noirs sur les photos pointent les régions où les analyses par FX ont été effectuées ; les résultats quantitatifs sont résumés sur la Figure 3.

Assay Office of the National Bank of Romania[2] that are routinely used for touchstone testing of gold jewelleries, and in which the Au content was determined by the fire assay method. For the quantification of Ag, the K X-ray lines of this element were employed. In this study, there was no special interest for the determination of trace elements that might have been contained in the gold alloy of the investigated artefacts; consequently, at this stage of the research, the interpretation of the results obtained was based only on the content of the major elements (Au, Ag and Cu). The relative standard deviations of the determined concentrations were less than 0.2% for Au and less than 2% for Ag and Cu.

2. Functioning nowadays as the Precious Metals and Precious Stones Department of the National Authority for Consumer Protection, Romania.

The ternary diagram (Au-Ag-Cu) in Figure 3 summarizes all concentrations (expressed in weight percent) obtained with the ARTAX spectrometer on different metallic parts of the buckle.

3. Results and discussion

Although the object we are examining today is only one buckle, we should not neglect the fact that the finite object was a belt, not a buckle. The obverse of the belt plate extends to a rectangular frame which connects the three elements of the buckle: the frame is bent around the link and welded on the back to a plain golden sheet having a shape identical to that of the belt plate. The hook of the tongue passes through the hole of the frame and is fastened to the ring.

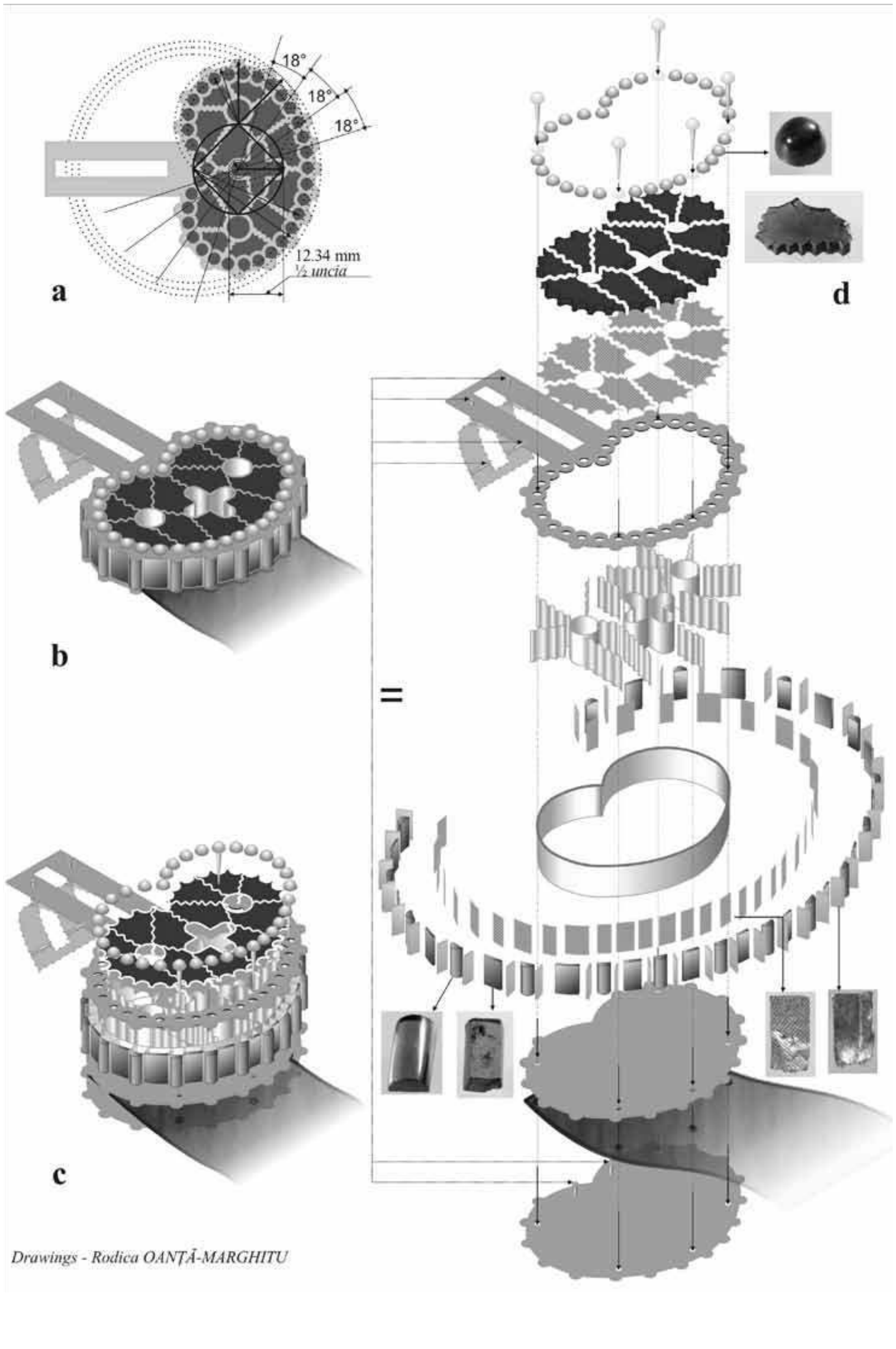

Figure 2: a. Geometrical construction of the decorative pattern; b. Reconstructed, ideal aspect of the buckle plate; c-d. Exploded view of the buckle plate.
Figure 2 : a. Construction géométrique du motif de décoration ; b. Reconstruction, aspect idéal de la plaque-boucle ; c-d. Vue éclatée de la plaque-boucle.

The distance between the reverse of the belt plate and the golden plain sheet was about 1-2 mm, corresponding to the belt's thickness. All these three 'layers' – the belt plate, the leather (or a type of textile material), and the golden foil on the reverse – were connected and fastened with four rivets – nowadays lost – whose hemispherical heads were integrated into the decoration and visible from the obverse. The same system could be observed on similar buckles preserved in the inventories of the first and second Apahida graves (Périn *et al.*, 2000: 176, 188).

The belt plate was assembled from more than 100 gold fragments and 74 garnets; the cells were initially filled with a kind of putty. By analogy with other buckles of the same category, we can assume that the quatrefoil and the round central cells were not inlaid with garnets. The graphical reconstruction in Figure 2, c-d, may give an idea about the complicated structure of this object.

By examining the shape of the belt plate and the geometrical composition of the cloisonné panel, it can be noticed how the peculiar kidney contour was created (Fig. 2a). Three corners of a square inscribed in a circle represent the centres of three other circles, joined to compose the kidney contour. The round prominences on the edge are evenly distributed at 18° intervals. The careful harmonious design of the buckle is also suggested by its proportions, which fit with a remarkable precision into the Roman measurement system (see Table 1) (Wikander, 2008: 766-767). Illustrative of this aspect, the *cloisonné* decoration of the belt plate is built around a quatrefoil cell with a length of 12.3 mm, which corresponds to ½ *uncia*.

In order to craft the *cloisonné* adorned jewellery, the goldsmiths had to assemble a lot of similar entities, like cell walls, gold patterned foils or garnets of different shapes. Thus, it is quite likely that before connecting all these elements in one single object, the craftsmen had to prepare all the necessary components, i.e. a complete set of S-shaped, Ω-shaped, undulated or simple rectangular cell walls.

Significant data about the crafting process of the buckle, especially regarding the preparation of all the elements to be assembled, were inferred from the XRF analysis of its components. In the diagram in Figure 3, one can notice several clusters, most likely corresponding to elements cut from the same gold ingot. Gold patterned foils can be found in one group, while the three longitudinal walls of the tongue, the Ω-shaped cell walls (used on the edge of the tongue kidney plate), as well as a patterned foil, are clustered in another group. A separate group corresponds to the S-shaped cell walls of the tongue. The obverse and the reverse golden thick foils of the buckle plate are clustered in the fourth group, while all the interior and edge cell walls of the buckle plate are found in the fifth group. Three isolated points correspond to the measurements of the link and four others to the tongue's hook. The same diagram suggests that perhaps for different sets of elements, 'prefabricated' components cut from different gold ingots were used.

It is worth emphasizing that the purity of the gold used to manufacture the buckle was never less than 22.5 karats. The gold concentration derived from the XRF measurements varies between a minimum of 94.0% for the link and a maximum of 99.4% for one of the patterned foils. The very high fineness of the patterned foils suggests that the goldsmith wished to take advantage of the remarkable malleability of pure gold. For the cell walls, an alloy with a lower gold content was chosen, a material which could at the same time ensure a high malleability to bend the gold straps in the appropriate shapes, as well as a certain hardness (the upper edges were always slightly bent over the stones). A possible explanation for the relatively high amount of silver and copper found in the link was that an alloy with improved mechanical properties was intentionally chosen to manufacture this component of the buckle. In particular, a constructive material with increased hardness makes this mobile element more resistant to stress and wearing.

Taking into account that the metallic composition of the cell walls depends on their shape, but does not show considerable differences, we could infer that the goldsmiths determined an optimal gold title for these elements. They prepared a certain number of similar cell walls and used

Dimensions (Fig. 1)	**Metric system** (mm)	**Roman system**		
		Pes (296 mm)	***Uncia*** (1/12 ***pes*** ≈ 24.7 mm)	***Digitus*** (1/16 ***pes*** ≈ 18.5 mm)
Diameter of the quatrefoil cell	12	1/24	1/12	2/3
Actual length (buckle + belt plate)	72	≤1/4	≤3	≤4
Large diameter of the buckle	57	1/5		
Length of the belt plate	54	≈ 2/11=1/5.5	≈ 11/5	<3
Width of the belt plate	37	1/8	3/2	2
Diameter of the large hemispherical garnet	3	1/96	1/8	1/6
Actual thickness of the belt plate	7,7			
Probable total thickness of the mounted belt plate	8,2	1/36	1/3	4/9
	9,3	1/32	3/8	1/2

Table 1: The dimensions of the Apahida III belt buckle.
Tableau 1 : Les dimensions de la boucle de ceinture d'Apahida III.

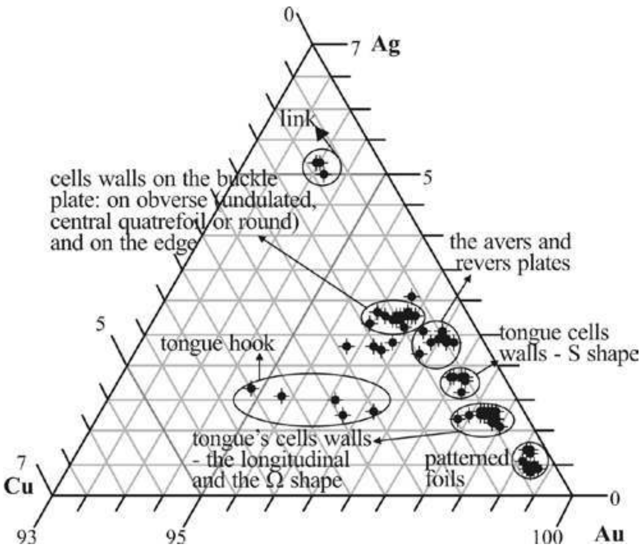

Figure 3: Ternary diagram (Au-Ag-Cu) of the concentrations (expressed in weight percent) determined by XRF on the Apahida III belt buckle.

Figure 3 : Diagramme ternaire (Au-Ag-Cu) des concentrations (exprimées en pourcent) déterminées par FX de la boucle de ceinturon d'Apahida III.

them to assemble different objects, depending on the requirements of the decoration design. They could also have used old, recuperated metal. Most likely, the available gold pieces were separated in different groups, according to their title, and used afterwards when an alloy of a certain type/purity was needed. In any case, we can assume the existence of an important degree of standardization in the workshop/workshops where adornments similar to this Apahida III buckle were produced. Thus, it is possible that large stocks of metallic elements, such as cell walls, cut into different shapes and sizes, were readily available at the actual moment of manufacturing the objects.

Recently, some test measurements on the garnets belonging to the Apahida belt buckle were also performed with the ARTAX spectrometer, this time in a helium-flushed atmosphere. Taking into account the results of these additional XRF analyses, as well as the previously published data on Merovingian gems (Calligaro *et al.*, 2002), the first conclusion was that the garnets used to decorate the Apahida III buckle were of different types, and, most likely, originated from different sources. The interpretation of the XRF results obtained on the garnets is still in progress, and further measurements are to be carried out.

Our investigation points out that the effective construction of the buckle was only the last phase of a much longer endeavour. The assembling process implied a well defined procedure with a precise sequence of operations, based on the exact knowledge of the required amount of raw materials and also of the characteristics (shapes and numbers) of the components (gold and garnets) to be assembled.

4. Conclusions

This paper summarizes a thorough study of the Apahida III belt buckle, which was recovered from a 5th century AD princely grave. Starting from the object's proportions, a geometrical pattern of the belt plate construction and decoration design was proposed. The buckle's appearance was first ideally conceptualized, and then a reference model was geometrically designed. By analyzing sets of several similar constructive elements, we gained a better understanding of the assembling process, underlining the stages of transforming an ideal project into a concrete object. It is highly possible that the workshop where the gold belt buckle from Apahida III was crafted employed a certain standardization of the objects, assembling components with similar shapes to obtain different adornments and different decorative patterns.

It is quite likely that, in order to produce new objects of this kind, recuperated metal was often used. The hypothesis of the use of 'prefabricated' elements – such as cell walls and garnets, cut into different shapes and sizes – to assemble *cloisonné* jewelleries of this kind appears reasonable. The main goal of the craftsmen was the final aspect of the object, which could include elements of variable gold purity, as it was demonstrated by the XRF analyses. In the structure of such elaborated objects as the garnet inlaid adornments of Apahida, the manufacturing process required not only a high technical background, but also a particular specialization of the craftsman and appropriate skills. Finally, the value of the object largely exceeded that of the gold and gems built in it, the intrinsic material value blending with the much more important symbolic one.

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